

Applicant: Fossey et al.
For: HIGH STRENGTH FABRIC AND STRUCTURE WITH UNIFORM THICKNESS AND A METHOD OF MAKING SAME

1 1. A high strength flexible fabric structure comprising:
2 a plurality of flexible fabric sections, each section including a
3 plurality of plies of alternating fiber orientation; and
4 a joint between adjacent sections wherein the plies of each section
5 are offset to form a uniform thickness seam between the two sections without any overlap
6 of plies of like fiber orientation.

1 2. The high strength flexible fabric structure of claim 1 in which there are at
2 least three plies in each section.

1 3. The high strength flexible fabric structure of claim 2 in which a first ply
2 has fibers oriented at 0° and 90°, a second ply has biased fibers, and a third ply has fibers
3 oriented at 0° and 90°.

1 4. The high strength flexible fabric structure of claim 3 in which the second
2 ply has fibers biased at ±45°.

1 5. The high strength flexible fabric structure of claim 1 in which the ply
2 fibers are woven.

1 6. The high strength flexible fabric structure of claim 1 in which the ply
2 fibers are knitted.

1 7. The high strength flexible fabric structure of claim 1 in which the ply
2 fibers are unidirectional.

1 8. The high strength flexible fabric structure of claim 1 in which the fibers of
2 each ply are disposed in a flexible matrix material.

1 9. The high strength flexible fabric structure of claim 8 in which the matrix
2 material is a polyurethane resin material.

1 10. The high strength flexible fabric structure of claim 1 in which the plies of
2 each section are heat welded together.
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4 11. The high strength flexible fabric structure of claim 1 in which the plies of
5 each section are laminated together.

1 12. The high strength flexible fabric structure of claim 1 in which the sections
2 are heat welded at the joint.

1 13. The high strength flexible fabric structure of claim 1 in which the sections
2 are laminated at the joint.

1 14. The high strength flexible fabric structure of claim 1 in which the structure
2 is a radome surrounding a radar system.

1 15. The high strength flexible fabric structure of claim 2 in which a first
2 section includes an edge with a first ply thereof extending outward from a second ply
3 which extends outward from a third ply and the adjacent second section has an adjacent
4 edge with a first ply thereof offset inward of a second ply which is offset inward of a third
5 ply such that at the joint between the two sections, the first ply of the first section is
6 disposed on the second ply of the second section, and the second ply of the first section is
7 disposed on the third ply of the second section.

1 16. The high strength flexible fabric structure of claim 1 in which there are at
2 least three plies in each section, the first ply having fibers oriented at 0° and 90°, the
3 second ply having biased fibers, and the third ply having fibers oriented at 0° and 90° and
4 in which the first section includes an edge with the first ply thereof extending outward
5 from the second ply which extends outward from the third ply and the adjacent second
6 section has an adjacent edge with the first ply thereof offset inward of the second ply
7 which is offset inward of the third ply such that at the joint between the two sections the
8 first ply of the first section is disposed on the second ply of the second section, and the
9 second ply of the first section is disposed on the third ply of the second section.

1 17. A high strength flexible fabric structure comprising:

2 a plurality of flexible fabric sections, each section including a

3 plurality of plies, each ply having fibers disposed in a flexible matrix; and

4 a joint between adjacent first and second sections wherein:

5 the first section has an edge with a first ply thereof

6 extending outward from a second ply;

7 the second adjacent section has an edge with a first ply

8 thereof offset inward from a second ply; and

9 the first ply of the first section is disposed on the second ply

10 of the second section.

1 18. The high strength flexible fabric structure of claim 17 in which:

2 the first section further includes a third ply offset inward from the

3 second ply of the first section;

4 the second adjacent section further includes a third ply extending

5 outward from the second ply of the second section; and

6 the second ply of the first section is disposed on the third ply of the

7 second section.

1 19. The high strength flexible fabric structure of claim 18 in which the first ply

2 of each section has fibers oriented at 0° and 90°, the second ply of each section has biased

3 fibers, and the third ply of each section has fibers oriented at 0° and 90°.

1 20. The high strength flexible fabric structure of claim 19 in which the second
2 ply has fibers biased at $\pm 45^\circ$.

1 21. The high strength flexible fabric structure of claim 17 in which the ply
2 fibers are woven.

1 22. The high strength flexible fabric structure of claim 17 in which the ply
2 fibers are knitted.

1 23. The high strength flexible fabric structure of claim 17 in which the ply
2 fibers are unidirectional.

1 24. The high strength flexible fabric structure of claim 17 in which the flexible
2 matrix is a polyurethane resin material.

1 25. The high strength flexible fabric structure of claim 17 in which the plies of
2 each section are heat welded together.

1 26. The high strength flexible fabric structure of claim 17 in which the plies of
2 each section are laminated together.

1 27. The high strength flexible fabric structure of claim 17 in which the
2 sections are heat welded at the joint.

1 28. The high strength flexible fabric structure of claim 17 in which the
2 sections are laminated at the joint.

1 29. The high strength flexible fabric structure of claim 17 in which the
2 structure is a radome surrounding a radar system.

1 30. A high strength flexible fabric structure comprising:

2 a plurality of flexible fabric sections, each section including at least
3 three plies, a first ply having fibers oriented at 0° and 90°, a second ply having fibers
4 biased at ±45°, and a third ply having fibers oriented at 0° and 90°; and

5 a joint between adjacent sections wherein the plies of each section
6 are offset to form a uniform thickness seam between two sections without overlap of plies
7 of like fiber orientation.

1 31. The high strength flexible fabric structure of claim 30 in which the ply
2 fibers are woven.

1 32. The high strength flexible fabric structure of claim 30 in which the ply
2 fibers are knitted.

1 33. The high strength flexible fabric structure of claim 30 in which the ply
2 fibers are unidirectional.

1 34. The high strength flexible fabric structure of claim 30 in which the
2 structure is a radome surrounding a radar system.

1 35. A flexible fabric structure with uniform seam thickness comprising:

2 a first fabric section comprising:

3 a first ply including a plurality of fibers oriented in a first

4 direction;

5 a second ply including a plurality of fibers oriented in a

6 second direction;

7 a third ply comprising a plurality of fibers oriented in the

8 first direction; and

9 a second fabric section comprising:

10 a first ply including a plurality of fibers oriented in the

11 first direction;

12 a second ply including a plurality of fibers oriented in the

13 second direction;

14 a third ply including a plurality of fibers oriented in the

15 first direction;

16 wherein a joint between the first and second sections is structured

17 and arranged such that the plies of the first section are in a staggered configuration with the

18 plies of the second section such that the joint has a thickness the same as the thickness of

19 the first and second fabric sections.

1 36. The fabric structure of claim 35 wherein the first direction is 0° and 90° .

1 37. The fabric structure of claim 35 wherein the second direction is $\pm 45^\circ$.

1 38. The fabric structure of claim 35 wherein the fibers are disposed in a
2 flexible resin matrix material.

1 39. A method of manufacturing a high strength flexible fabric structure, the
2 method comprising:

3 forming a plurality of flexible fabric sections to each include a
4 plurality of plies of alternating fiber orientation;
5 offsetting the plies of each section; and
6 joining adjacent sections such that no plies of like fiber orientation
7 overlap.

1 40. The method of claim 39 in which there are at least three plies in each
2 section.

1 41. The method of claim 40 in which the first ply has fibers oriented at 0° and
2 90°, the second ply has biased fibers, and the third ply has fibers oriented at 0° and 90°.

1 42. The method of claim 41 in which the second ply has fibers biased at $\pm 45^\circ$.

1 43. The method of claim 39 in which forming the flexible fabric sections
2 includes weaving the ply fibers.

1 44. The method of claim 39 in which forming the flexible fabric sections
2 includes disposing the fibers of each ply in a flexible matrix material.

1 45. The method of claim 44 in which the matrix material is a polyurethane

2 resin material.

1 46. The method of claim 39 in which joining of the sections includes heat
2 welding the plies of each section together.

1 47. The method of claim 39 in which joining of the sections includes
2 laminating the plies of each section together.

1 48. The method of claim 39 in which joining of the sections includes heat
2 welding the sections at the joint.

1 49. The method of claim 39 in which joining of the sections includes
2 laminating the sections at the joint.

1 50. The method of claim 39 further including the step of configuring the
2 flexible fabric sections as a radome covering.

1 51. The method of claim 40 in which offsetting includes extending a first ply of
2 a first section outward from a second ply thereof and extending the second ply outward
3 from a third ply thereof and offsetting a first ply of the second section inward from a second
4 ply thereof and offsetting the second ply thereof inward from a third ply thereof.

1 52. The method of claim 51 in which joining includes disposing the first ply of

- 2 the first section on the second ply of the second section and disposing the second ply of the
- 3 first section on the third ply of the second section.

1 53. A method of producing a fabric structure of uniform thickness, the method
2 comprising:

3 forming a plurality of fabric sections; and
4 structuring and arranging each section to abut and join an adjacent
5 section without any overlap between the sections and forming a fabric structure of
6 uniform thickness.

1 54. A method for producing a flexible fabric structure of uniform thickness,
2 the method comprising:

3 forming a first flexible fabric portion with a first ply of flexible
4 fabric including a plurality of fibers oriented at 0° and 90°, a second ply of flexible fabric
5 including a plurality of fibers oriented at ±45°, and a third ply of flexible fabric including
6 a plurality of fibers oriented at 0° and 90°,

7 stacking the first, second, and third plies; and

8 joining the first, second, and third plies with like oriented plies of a
9 second flexible fabric portion in an offset configuration and forming a uniform thickness
10 seam.

1 55. A high strength flexible fabric seam comprising:
2 at least two flexible fabric sections, each section including a
3 plurality of plies of alternating fiber orientation, wherein the plies of each section are
4 offset and joined without any overlap of plies of like fiber orientation.

1 56. The high strength flexible fabric seam of claim 55 in which there are at
2 least three plies in each section.

1 57. The high strength flexible fabric seam of claim 56 in which the first ply
2 has fibers oriented at 0° and 90°, the second ply has biased fibers, and the third ply has
3 fibers oriented at 0° and 90°.

1 58. The high strength flexible fabric seam of claim 57 in which the second ply
2 has fibers biased at $\pm 45^\circ$.

1 59. The high strength flexible fabric seam of claim 55 in which the ply fibers
2 are woven.

1 60. The high strength flexible fabric seam of claim 55 in which the ply fibers
2 are knitted.

1 61. The high strength flexible fabric seam of claim 55 in which the ply fibers
2 are unidirectional.

1 62. The high strength flexible fabric seam of claim 55 in which the fibers of
2 each ply are disposed in a flexible matrix material.

1 63. The high strength flexible fabric seam of claim 62 in which the matrix
2 material is a polyurethane resin material.

1 64. The high strength flexible fabric seam of claim 55 in which the plies of
2 each section are heat welded together.

1 65. The high strength flexible fabric seam of claim 55 in which the plies of
2 each section are laminated together.

1 66. The high strength flexible fabric seam of claim 55 in which the sections
2 are heat welded together.

1 67. The high strength flexible fabric seam of claim 55 in which the sections
2 are laminated together.

1 68. The high strength flexible fabric seam of claim 56 in which a first section
2 includes an edge with the first ply thereof extending outward from the second ply which
3 extends outward from the third ply and the adjacent second section has an adjacent edge
4 with the first ply thereof offset inward of the second ply which is offset inward of the
5 third ply such that the first ply of the first section is disposed on the second ply of the

6 second section, and the second ply of the first section is disposed on the third ply of the
7 second section.

1 69. The high strength flexible fabric seam of claim 55 in which there are at
2 least three plies in each section, the first ply having fibers oriented at 0° and 90°, the
3 second ply having biased fibers, and the third ply having fibers oriented at 0° and 90° in
4 which a first section includes an edge with the first ply thereof extending outward from
5 the second ply which extends outward from the third ply and the adjacent second section
6 has an adjacent edge with the first ply thereof offset inward of the second ply which is
7 offset inward of the third ply such that the first ply of the first section is disposed on the
8 second ply of the second section, and the second ply of the first section is disposed on the
9 third ply of the second section.

1 70. A high strength flexible fabric seam comprising:
2 at least two flexible fabric sections, each section including a plurality of
3 plies, each ply having fibers disposed in a flexible matrix wherein the first section has an
4 edge with a first ply thereof extending outward from a second ply;
5 the second adjacent section has an edge with a first ply thereof offset
6 inward from a second ply; and
7 the first ply of the first section is disposed on the second ply of the second
8 section.

1 71. The high strength flexible fabric seam of claim 70 in which:
2 the first section includes a third ply offset inward from the second
3 ply of the first section;
4 the second adjacent section includes a third ply extending outward
5 from the second ply of the second section; and
6 the second ply of the first section is disposed on the third ply of the
7 second section.

1 72. The high strength flexible fabric seam of claim 71 in which the first ply of
2 each section has fibers oriented at 0° and 90°, the second ply has biased fibers, and the
3 third ply has fibers oriented at 0° and 90°.

1 73. A flexible fabric seam with uniform thickness comprising:

2 a first fabric section comprising:

3 a first ply including a plurality of fibers oriented in a first

4 direction;

5 a second ply including a plurality of fibers oriented in a

6 second direction;

7 a third ply comprising a plurality of fibers oriented in the

8 first direction; and

9 a second fabric section comprising:

10 a first ply including a plurality of fibers oriented in the

11 first direction;

12 a second ply including a plurality of fibers oriented in the

13 second direction;

14 a third ply including a plurality of fibers oriented in the

15 first direction;

16 wherein the plies of the first section are in a staggered configuration

17 with and joined with the plies of the second section such that the seam has a thickness equal

18 to a combined thickness of the first, second, and third layers of the first and second fabric

19 sections.

1 74. A method of manufacturing a high strength flexible fabric seam, the
2 method comprising:

3 forming a plurality of flexible fabric sections to each include a
4 plurality of plies of alternating fiber orientation;
5 offsetting the plies of each section; and
6 joining adjacent sections such that no plies of like fiber orientation
7 overlap.

1 75. The method of claim 74 in which offsetting includes extending the first ply
2 of a first section outward from the second ply thereof and extending the second ply outward
3 from the third ply thereof and offsetting the first ply of the second section inward from the
4 second ply thereof and offsetting the second ply thereof inward from the third ply thereof.

1 76. The method of claim 75 in which joining includes disposing the first ply of
2 the first section on the second ply of the second section and disposing the second ply of the
3 first section on the third ply of the second section.

1 77. A method of manufacturing a high strength flexible fabric seam, the
2 method comprising:

3 forming a plurality of flexible fabric sections to each include at
4 least three of plies of alternating fiber orientation;

5 offsetting the plies of each section;

6 joining adjacent sections such that no plies of like fiber orientation
7 overlap;

8 weaving the ply fibers; and

9 disposing the fibers of each ply in a flexible matrix material.

1 78. A radome structure comprising:
2 a plurality of flexible fabric sections, each section including a
3 plurality of plies of alternating fiber orientation; and
4 a joint between adjacent sections wherein the plies of each section
5 are offset to form a uniform thickness seam between the two sections without any overlap
6 of plies of like fiber orientation.